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| APPLICATION NO.                  | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO.        | CONFIRMATION NO. |
|----------------------------------|-------------|----------------------|----------------------------|------------------|
| 10/706,904                       | 11/12/2003  | Jinhan Choi          | AMAT 8247/ETCH/<br>SILICON | 7747             |
| 44182                            | 7590        | 08/22/2005           | EXAMINER                   |                  |
| MOSER, PATTERSON & SHERIDAN, LLP |             |                      | TRAN, BINH X               |                  |
| APPLIED MATERIALS INC            |             |                      | ART UNIT                   | PAPER NUMBER     |
| 595 SHREWSBURY AVE               |             |                      |                            |                  |
| SUITE 100                        |             |                      | 1765                       |                  |
| SHREWSBURY, NJ 07702             |             |                      | DATE MAILED: 08/22/2005    |                  |

Please find below and/or attached an Office communication concerning this application or proceeding.

|                              |                          |                     |  |
|------------------------------|--------------------------|---------------------|--|
| <b>Office Action Summary</b> | <b>Application No.</b>   | <b>Applicant(s)</b> |  |
|                              | 10/706,904               | CHOI ET AL.         |  |
|                              | Examiner<br>Binh X. Tran | Art Unit<br>1765    |  |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

#### Status

- 1) Responsive to communication(s) filed on 12 November 2003.
- 2a) This action is FINAL.                            2b) This action is non-final.
- 3) Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

#### Disposition of Claims

- 4) Claim(s) 1-19 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) Claim(s) \_\_\_\_\_ is/are allowed.
- 6) Claim(s) 1-19 is/are rejected.
- 7) Claim(s) \_\_\_\_\_ is/are objected to.
- 8) Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

#### Application Papers

- 9) The specification is objected to by the Examiner.
- 10) The drawing(s) filed on \_\_\_\_\_ is/are: a) accepted or b) objected to by the Examiner.  
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

#### Priority under 35 U.S.C. § 119

- 12) Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
  - a) All    b) Some \* c) None of:
    1. Certified copies of the priority documents have been received.
    2. Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
    3. Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

#### Attachment(s)

|  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)  | 4) <input type="checkbox"/> Interview Summary (PTO-413)                     |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)   | Paper No(s)/Mail Date. _____  |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date <u>2-20-04</u> . | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
|  | 6) <input type="checkbox"/> Other: _____                                    |

## DETAILED ACTION

### ***Claim Rejections - 35 USC § 112***

1. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

2. Claims 2-3, 10, 16 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

In claim 2-3, “selected from a group containing” (emphasis added) is indefinite for improper use of Markush language. The examiner suggests replacing “selected from a group containing” with --selected from the group consisting of--.

Where applicant acts as his or her own lexicographer to specifically define a term of a claim contrary to its ordinary meaning, the written description must clearly redefine the claim term and set forth the uncommon definition so as to put one reasonably skilled in the art on notice that the applicant intended to so redefine that claim term. *Process Control Corp. v. HydReclaim Corp.*, 190 F.3d 1350, 1357, 52 USPQ2d 1029, 1033 (Fed. Cir. 1999). The term “cm<sup>3</sup>” (greater than 10<sup>11</sup> cm<sup>3</sup>) in claims 10 and 16 is used by the claim to mean “the density unit of plasma”, while the accepted meaning is “the unit of volume.” The term is indefinite because the specification does not clearly redefine the term. The plasma density must have the unit of ion/cm<sup>3</sup> or atom/cm<sup>3</sup> (i.e. ion or atom per unit of volume). The “cm<sup>3</sup>” is the volume unit.

### ***Claim Rejections - 35 USC § 102***

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3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

4. Claims 1-3, 5-8, 13-15 are rejected under 35 U.S.C. 102(e) as being anticipated by Donohoe et al. (US 6,890,863).

Respect to claim 1, Donohoe discloses a plasma etching a layer of oxide with a chamber (chamber 10, inductive plasma source or IPS) comprising:

supplying a gas mixture containing a fluorocarbon gas and a fluorohydrocarbon gas to the chamber (col. 5 lines 50-60);

igniting high-density plasma within the chamber by coupling RF energy (i.e. RF discharge unit) to the gas mixture (col. 7 lines 55-65);

etching the oxide layer (col. 6 lines 5-11).

Respect to claim 2, Donohoe discloses the fluorocarbon gas is selected from the group consisting of  $\text{CF}_4$  and  $\text{C}_4\text{F}_8$  (col. 5 lines 59-62). Respect to claim 3, Donohoe discloses the fluorohydrocarbon gas is selected from the group consisting of  $\text{CHF}_3$ ,  $\text{CH}_2\text{F}_2$  and  $\text{CH}_3\text{F}$  (col. 5 lines 57-59).

Respect to claim 5, Donohoe discloses the step of applying bias power to a cathode electrode of 400-800 Watts, preferably from about 500-700 Watts (col. 6 lines 64-67, within applicant's range of 200-500 watts). Respect to claim 6, Donohoe

discloses the step of applying an inductive source power to an antenna of 750-1250 Watts (col. 6 lines 59-60; within applicant's range of 400 to 1500 Watts).

Respect to claim 7, Donohoe discloses the chamber pressure is between 10-40 mtorr (col. 5 lines 65-67, within applicant's range of 4 to 60 mtorr). Respect to claim 8, Donohoe disclose substrate support (i.e. pedestal) within the chamber is maintained at a temperature between -20 °C to 80 °C (col. 6 lines 53-55, within applicant's range of 0 °C to 100 °C).

Respect to claim 13, Donohoe discloses igniting a plasma within the IPS chamber by applying a bias power to cathode electrode of about 500 Watts (col. 12 lines 3-5) and an inductive source power to an inductively coupled antenna (32) of about 700 Watts (col. 11 lines 61-64). The limitation of claims 14-15 has been discussed above.

5. Claims 1-5, 7 are rejected under 35 U.S.C. 102(e) as being anticipated by Miller et al. (US 6,432,832).

Respect to claims 1-3, Miller discloses a plasma etching a layer of oxide with a chamber comprising:

supplying a gas mixture containing a fluorocarbon gas ( $\text{CF}_4$ ) and a fluorohydrocarbon ( $\text{CHF}_3$  or  $\text{CH}_2\text{F}_2$ ) gas to the chamber (col. 9 lines 57-60);  
igniting high-density plasma within the chamber by coupling RF energy (i.e. RF power) to the gas mixture (col. 9 lines 63-67);  
etching the oxide layer.

Respect to claim 4, Miller teaches to use 10-70 sccm CF<sub>4</sub> and 20-100 sccm CHF<sub>3</sub> (col. 10 lines 1-10). Miller further teaches that CH<sub>2</sub>F<sub>2</sub> may be interchangeable with CHF<sub>3</sub> (col. 9 lines 58-60). Therefore, the examiner interprets that Miller implicitly teaches to use CH<sub>2</sub>F<sub>2</sub> at the flow rate of 20-100 scmm.

Respect to claim 5, Miller teaches to apply bias power to the bottom electrode (i.e. cathode electrode) from 50-300 Watts, preferably 200 Watts (col. 9 lines 65-67, within applicant's range). Respect to claim 7, Miller teaches to maintain the pressure between 5-70 mtorr (col. 9 lines 60-61, within applicant's range of 4-60 mtorr).

***Claim Rejections - 35 USC § 103***

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

7. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

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8. Claim 9 IS rejected under 35 U.S.C. 103(a) as being unpatentable over Miller in view of Brask et al. (US 2004/0259324).

Respect to claim 9, Miller fails to disclose the specific selectivity value of oxide to photoresist. Brask teaches to etch oxide to photoresist with a high selectivity using CF<sub>4</sub> and CH<sub>2</sub>F<sub>2</sub> (paragraph 0075-0076). Brask further disclose selectivity is a result effective variable is commonly determined by routine experiment. The process of conducting routine experiments so as to produce an expected result is obvious to one of ordinary skill in the art. Hence, it would have been obvious to one having ordinary skill in the art, at the time of invention, to perform routine experiment to obtain optimal selectivity as an expected result.

9. Claims 10, 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Donohoe in view of Ko (US 6,849,557).

Respect to claim 10 and 16, Donohoe fails to disclose the specific plasma density value. In a semiconductor etching process, Ko teaches to use high-density plasma having the density range from 10<sup>12</sup>/cm<sup>3</sup> to 10<sup>13</sup>/cm<sup>3</sup> (col. 4 lines 55-61, read on greater than 1011). It would have been obvious to one having ordinary skill in the art, at the time of invention, to modify Donohoe in view of Ko by using high-density plasma having a density greater than 10<sup>11</sup> ions/cm<sup>3</sup> because it will enhance the etching rate.

10. Claim 11 is rejected under 35 U.S.C. 103(a) as being unpatentable over Miller et al. (US 6,432,832).

Respect to claim 11, Miller fails to explicitly disclose the flow rate ratio of CF<sub>4</sub>:CH<sub>2</sub>F<sub>2</sub> of 1:1.5. However, Miller clearly teaches the flow rate ratio of CHF<sub>3</sub> and CF4

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is a result effective variable range from 100% (1:1) to 500% (1:5) (col. 10 lines 1-15).

Miller further teaches that  $\text{CH}_2\text{F}_2$  may be interchangeable with  $\text{CHF}_3$ . Thus, the examiner interprets that Miller implicitly teaches the flow rate ratio of  $\text{CF}_4:\text{CH}_2\text{F}_2$  is a result effective variable ranging from 1:1 to 1:5. The result effective variable is commonly determined by routine experiment. The process of conducting routine experiments so as to produce an expected result is obvious to one of ordinary skill in the art. Hence, it would have been obvious to one having ordinary skill in the art, at the time of invention, to perform routine experiment to obtain optimal flow rate ratio as an expected result.

11. Claim 17 is rejected under 35 U.S.C. 103(a) as being unpatentable over Donohoe in view of Miller.

Respect to claim 11, Donohoe fails to explicitly disclose the flow rate ratio of  $\text{CF}_4:\text{CH}_2\text{F}_2$  of 1:1.5. However, Donohoe clearly teaches to control the flow rate ratio of fluorocarbon and hydrofluorocarbon is a result effective variable. Miller clearly teaches the flow rate ratio of  $\text{CHF}_3$  and  $\text{CF}_4$  is a result effective variable range from 100% (1:1) to 500% (1:5) (col. 10 lines 1-15). Miller further teaches that  $\text{CH}_2\text{F}_2$  may be interchangeable with  $\text{CHF}_3$ . Thus, the examiner interprets that Miller implicitly teaches the flow rate ratio of  $\text{CF}_4:\text{CH}_2\text{F}_2$  is a result effective variable ranging from 1:1 to 1:5 (within applicant's range). The result effective variable is commonly determined by routine experiment. The process of conducting routine experiments so as to produce an expected result is obvious to one of ordinary skill in the art. Hence, it would have been obvious to one having ordinary skill in the art, at the time of invention, to modify

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Donohoe in view of Miller to perform routine experiment to obtain optimal flow rate ratio as an expected result.

12a. Claim 12 is rejected under 35 U.S.C. 103(a) as being unpatentable over Miller in view of Brase et al. (US 2002/0146906).

12b. Claim 18 is rejected under 35 U.S.C. 103(a) as being unpatentable over Donohoe in view of Miller and further in view of Brase et al..

Respect to claim 9, Donohoe and Miller fail to disclose adjusting the ratio of CF<sub>4</sub>:CH<sub>2</sub>F<sub>2</sub> controls a selectivity of oxide over photoresist. However, Donohoe and Miller teach to use CF<sub>4</sub>, CH<sub>2</sub>F<sub>2</sub> to etch oxide over photoresist layer. Miller further teaches CH<sub>2</sub>F<sub>2</sub> may be interchangeable with CHF<sub>3</sub>. Brase teaches to control the selectivity of oxide over photoresist by adjusting the flow rate ratio of CF<sub>4</sub>, CHF<sub>3</sub> (paragraph 0036-0041). Since, CH<sub>2</sub>F<sub>2</sub> is interchangeable with CHF<sub>3</sub>, it would have been obvious to one having ordinary skill in the art, at the time of invention, to modify Donohoe and/or Miller in view Brase by adjusting the flow rate ratio of CF<sub>4</sub> and CH<sub>2</sub>F<sub>2</sub> because it will enhance the selectivity with respect to the photoresist layer.

13. Claim 19 is rejected under 35 U.S.C. 103(a) as being unpatentable over Donohoe in view of Pyun (US 6,238,973).

Respect to claim 19, Donohoe fails to disclose the gas mixture further comprises HeO<sub>2</sub>. In an etching process, Pyun teaches to use HeO<sub>2</sub> in order to enhance etch selectivity (col. 7 lines 25-28). It would have been obvious to one having ordinary skill in the art, at the time of invention, to modify Donohoe in view of Pyun by using HeO<sub>2</sub> because it will enhance the etch selectivity.

***Conclusion***

14. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Binh X. Tran whose telephone number is (571) 272-1469. The examiner can normally be reached on Monday-Thursday and every other Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on (571) 272-1465. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

*Binh Tran*

Binh X. Tran